

<b>TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED / ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371</b>		ATTORNEY'S DOCKET NUMBER <b>P67515US0</b>
		US APPLICATION NO. <b>107019289</b>
INTERNATIONAL APPLICATION NO. <b>PCT/BE00/00080</b>	INTERNATIONAL FILING DATE <b>5 July 2000</b>	PRIORITY DATE CLAIMED <b>5 July 1999</b>
TITLE OF INVENTION <b>PROCESS FOR ASSEMBLING AT LEAST TWO CONSTITUENT METAL PARTS IN ORDER TO CREATE A STRUCTURE</b>		
APPLICANT(S) FOR DO/EQ/US <b>Richard KERGEN</b>		

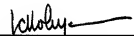
**Applicant herein submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information.**

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for Internatl. Preliminary Examination was made by the 19th month from earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☒ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☒ A translation of the annexes to the Internatl. Preliminary Examination report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**Items 11. to 16. below concern other document(s) or information included:**

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
  - ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:

International Search Report - EPO  
 PCT Request Form  
 PCT/IB/301 Form  
 PCT/IB/304 Form  
 PCT/IB/308 Form  
 First Page of Publication  
 International Preliminary Examination Report - with annexes  
 Verification of Translation

US APPLICATION NO. (If known, fill in 37 CFR 1.51) <b>10/019289</b>		INTERNATIONAL APPLICATION NO. <b>PCT/BE00/00080</b>		ATTORNEY'S DOCKET NUMBER <b>P67515US0</b>	
<b>17. The following fees are submitted:</b>  <b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> Internat'l. prelim. examination fee paid to USPTO (37 CFR 1.492 (a) (1)) .. \$710.00 No international preliminary examination fee paid to USPTO (37 CFR 1.492 (a) (2)) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) .. \$740.00 Neither international preliminary examination fee (37 CFR 1.492 (a) (3)) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO) ..... <b>\$1040.00</b> International preliminary examination fee paid to USPTO (37 CFR 1.492 (a) (4)) and all claims satisfied provisions of PCT Article 33(2)-(4) ..... \$100.00 Search Report prepared by the EPO or JPO (37 CFR 1.492 (a) (5)) ..... <b>\$990.00</b>  <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				CALCULATIONS	PTO USE ONLY
				\$ 890.00	
Surcharge of \$130.00 for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	13 - 20 =	-0-	x \$18.00	\$	
Independent Claims	1 - 3 =	-0-	x \$84.00	\$	
Multiple Dependent Claim(s) (if applicable)			+ \$280.00	\$	
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$ 890.00	
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$	
<b>SUBTOTAL =</b>				\$ 890.00	
Processing fee of \$130 for furnishing the English translation later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(f))				\$	
<b>TOTAL NATIONAL FEE =</b>				\$ 890.00	
Fee of \$40.00 for recording the enclosed assignment (37 CFR 1.21(h)). Assignment must be accompanied by appropriate cover sheet (37 CFR 3.28, 3.31).				\$ 40.00	
<b>TOTAL FEES ENCLOSED =</b>				\$ 930.00	
				Amt. to be refunded:	\$
				Amt. charged:	\$
a. <input checked="" type="checkbox"/> A check in the amount of \$ <u>930.00</u> to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. <u>06-1358</u> in the amount of \$ _____ to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge my account any additional fees set forth in §1.492 during the pendency of this application, or credit any overpayment to Deposit Account No. <u>06-1358</u> . A duplicate copy of this sheet is enclosed.					
SEND ALL CORRESPONDENCE TO:  <b>JACOBSON HOLMAN PLLC</b> 400 7th Street, N.W., Suite 600 Washington, DC 20004 202-638-6666 <b>CUSTOMER NUMBER: 00136</b>					
				By <u></u>	
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Richard KERGEN

Serial No.: New

Filing Date: January 4, 2002

For: PROCESS FOR ASSEMBLING AT LEAST TWO CONSTITUENT  
METAL PARTS IN ORDER TO CREATE A STRUCTURE

PRELIMINARY AMENDMENT

Commissioner for Patents  
Washington, D.C. 20231

Sir:

Prior to initial examination, please amend the above-  
identified application as follows:

IN THE SPECIFICATION

On page 1, immediately following the title, please insert the  
following sentence: --This is a nationalization of PCT/BE00/00080  
filed July 5, 2000 and published in French.--

IN THE CLAIMS

Please amend claims 4-9 and 11-13 as follows:

4. (amended) Assembly process according to Claim 1, characterized  
in that the ratio of the radius of the hem (4) to the sum of the  
thicknesses of the various parts one wishes to assemble along the  
junction section is between 2 and 10.

5. (amended) Assembly process according to Claim 1, characterized

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in that the ratio of the difference between the radius of the hem (4) and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

6. (amended) Assembly process according to Claim 1, characterized in that the nature or thickness of the various parts is not identical for all.

7. (amended) Assembly process according to Claim 1, characterized in that the junction is not rectilinear and has a local curvature, the radius of which is more than at least five times the external radius of the hem (4).

8. (amended) Assembly process according to Claim 1, characterized in that, after said hem crimping, blocking of said hem with respect to the sliding of the assembled parts along the junction section is achieved by bonding, indentation or imbrication.

9. (amended) Product obtained by the assembly process described in Claim 1, characterized in that it has at least two simple sheet metal parts (1, 2, 3; 11, 12,; 21, 21', 22, 22') in order to create a structural component of open cross section, which is preferably U-shaped, at least one said metal part having a high or very high elastic limit and low formability, characterized in that the metal parts have been formed by at least a bending process and are arranged with respect to each other along a junction section and are assembled with a hem (4) along said junction section, said hem mechanically reinforcing the structure.

11. (amended) Product according to Claim 9, characterized in that

the ratio of the difference between the hem (4) radius and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

12. (amended) Product according to Claim 9, characterized in that it is in the form of a two-web I-shaped girder obtained by assembling four constituent parts (21, 21', 22, 22') connected by four hems (4) along the junction section of the four parts taken in pairs.

13. (amended) Product according to Claim 9, characterized in that it results from the assembly of two parts (11, 12) by means of two hems (4) so as to form a closed cross section, at least one of the two parts having a U-shaped cross section.

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**REMARKS**

The foregoing Preliminary Amendment is requested in order to delete the multiple dependent claims and avoid paying the multiple dependent claims fee.

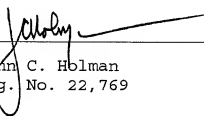
Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE."

Early action on the merits is respectfully requested.

Respectfully submitted,

JACOBSON HOLMAN PLLC

By

  
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Atty. Docket: P67515US0  
Date: January 4, 2002  
JCH/cmf

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

4. (amended) Assembly process according to Claim 1 [any one of Claims 1 to 3], characterized in that the ratio of the radius of the hem (4) to the sum of the thicknesses of the various parts one wishes to assemble along the junction section is between 2 and 10.

5. (amended) Assembly process according to Claim 1 [any one of Claims 1 to 3], characterized in that the ratio of the difference between the radius of the hem (4) and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

6. (amended) Assembly process according to Claim 1 [any one of the preceding claims], characterized in that the nature or thickness of the various parts is not identical for all.

7. (amended) Assembly process according to Claim 1 [any one of the preceding claims], characterized in that the junction is not rectilinear and has a local curvature, the radius of which is more than at least five times the external radius of the hem (4).

8. (amended) Assembly process according to Claim 1 [any one of the preceding claims], characterized in that, after said hem crimping, blocking of said hem with respect to the sliding of the assembled parts along the junction section is achieved by bonding, indentation or imbrication.

9. (amended) Product obtained by the assembly process described in

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Claim 1 [any one of the preceding claims], characterized in that it has at least two simple sheet metal parts (1, 2, 3; 11, 12,; 21, 21', 22, 22') in order to create a structural component of open cross section, which is preferably U-shaped, at least one said metal part having a high or very high elastic limit and low formability, characterized in that the metal parts have been formed by at least a bending process and are arranged with respect to each other along a junction section and are assembled with a hem (4) along said junction section, said hem mechanically reinforcing the structure.

11. (amended) Product according to Claim 9 [or 10], characterized in that the ratio of the difference between the hem (4) radius and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

12. (amended) Product according to Claim 9 [any one of Claims 9 to 11], characterized in that it is in the form of a two-web I-shaped girder obtained by assembling four constituent parts (21, 21', 22, 22') connected by four hems (4) along the junction section of the four parts taken in pairs.

13. (amended) Product according to Claim 9 [any one of Claims 9 to 11], characterized in that it results from the assembly of two parts (11, 12) by means of two hems (4) so as to form a closed cross section, at least one of the two parts having a U-shaped cross section.



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PROCESS FOR ASSEMBLING AT LEAST TWO CONSTITUENT METAL  
PARTS IN ORDER TO CREATE A STRUCTURE

10 Object of the invention

[0001] The present invention relates to a process for assembling at least two metal parts in order to create a structure, at least one of the two parts having a very high elastic limit, and to its use for producing (girder) structures of complex form from simple parts, that do not require large deformations.

Technical background and prior art

[0002] In the field of mechanical construction and in particular in the automotive field, the objective is to substantially reduce the weight of structures by using the least possible amount of metal. These structures, for example motor vehicle chassis, are obtained by assembling often complex components, performed by drawing.

[0003] In order to reduce the thickness of the metal used to produce these structures, while at the same time conserving their mechanical properties, steels with high mechanical characteristics are to be used. Grades of low alloy carbon steels with high mechanical characteristics are nowadays available, but are often associated with a very limited formability by deformation.

[0004] To clarify matters, we will differentiate these steels according to their elastic limit (EL) in the remainder of the description:

- mild steels:  $EL < 250 \text{ MPa}$ ;
- steels with a high elastic limit (HEL):  
 $250 \text{ MPa} < EL < 600 \text{ MPa}$ ;
- steels with a very high elastic limit (VHEL):  
5  $600 \text{ MPa} < EL < 1000 \text{ MPa}$ ;
- steels with an ultra-high elastic limit (UHEL):  
 $1000 \text{ MPa} < EL < 1500 \text{ MPa}$ .

[0005] Typically, the steels to which this patent application is related have an elastic limit of between  
10 400 and 1500 MPa. These steels are produced by bulk metallurgical processes that are known per se, which allow to offer steels at a cost price close to that of standard carbon steels. The advantage then lies in the fact that an appreciable lightening of the structure can be obtained.

15 However, on account of their low formability and a sometimes poor weldability, these steels pose specific problems in terms of implementation, and in particular of assembly.

[0006] More particularly, the constituent parts of a  
20 same structure often have complex forms obtained by drawing processes which involve large deformations, and are thus incompatible with the low formability characteristics of these steels.

[0007] The process of mechanical hem crimping or the  
25 like is well known, for example for assembling parts such as ladders in the field of metal joinery. Thus, document US-A-4 356 888 describes a structural joint for two parts, preferably made of malleable and deformable metal, such as aluminium. According to one particular embodiment, the  
30 first part has an elongated tongue and a short tongue. These two tongues define a cavity capable of receiving the second part at the level of a curved tab on a support such as a wire. When the two parts are pressed together using a suitable tool, the tongues and the tab are deformed and

interpenetrate. The elongated tongue forms at least partially a circular loop around the tab, thus making any subsequent stripping impossible.

[0008] In the same field of application, document  
5 US-A-3 854 185 proposes a process for forming a structural joint between two rigid parts, one having a flange with a protruding end on one face, and the other having an essentially circular groove. By pressing the two pieces against one another with sufficient force, the flange  
10 penetrates into the groove while becoming deformed. More specifically, the assembly is performed by securely fastening the flange to the groove, the flange forming a winding in said groove.

[0009] Document DE-C-385 642 proposes a machine for  
15 crimp assembling two plate metal parts in order to form a hollow body.

[0010] Document FR-A-2 321 962 proposes a process for crimp assembling a zinc part and a lead part in order to solve the sealing problems which arise in the field of  
20 construction roofing.

#### Aims of the invention

[0011] The present invention aims to propose a process  
25 for assembling at least two constituent metal parts or components, at least one of which is made of a steel with a very high elastic limit associated with low formability, in order to produce structural components of complex form from simpler components which may be produced by means of forming operations essentially of the bending type, which  
30 does not involve any large deformations in the plane of the metal plate and is thus compatible with steels having high mechanical characteristics.

[0012] Indeed, within a given family of alloys, steels for example, or alternatively aluminium alloys, the higher

the elastic limit, the lower the ductility. The level of the elastic limit associated with this low formability depends on the alloy family taken into consideration; thus, this limit may be from 600 to 800 MPa for steels, depending on the grade taken into consideration. Beyond that limit, the steels can only be draw-formed with great difficulty: deformations in the plane of the plate metal by broad tension or expansion will rapidly lead to its breaking. The resilience also makes it very difficult to comply with the geometry of the component. On the other hand, these steels retain deformability by bending. However, since the limiting bend radius is several times the thickness, assembly by crimping is virtually impossible.

[0013] However, these steels are of potential value for improving metal structures and in particular motor vehicle structures. They allow to reduce the weight for equivalent performance or even to improve the performance for equivalent weight.

[0014] It is therefore important to be able to produce components in complex forms from these metals with high mechanical characteristics, which is the object of the present invention.

#### Main characteristic elements of the invention

[0015] The present invention relates to a process for assembling at least two simple sheet metal parts, in order to create a structural component of open cross section, preferably U-shaped, or of closed cross section, at least one of said metal parts having a high or very high elastic limit and low formability, characterized in that:

- the metal parts are formed by at least one bending process;

- the metal parts are arranged relative to each other in a junction section;
- the metal parts are assembled by crimping at the hem (4) along the junction section of said parts.

5 [0016] At least one of the parts is preferably made of a steel with an elastic limit of more than 400 MPa or of an aluminium alloy with an elastic limit of more than 200 MPa.

10 [0017] Advantageously, the ratio of the hem radius to the sum of the thicknesses of the various parts one wishes to assemble along the junction section is between 2 and 10.

15 [0018] Furthermore, the ratio of the difference between the radius of the hem and the thickness of the outermost metal with the thickness of the innermost metal is advantageously greater than 2.

[0019] The nature or thickness of the various parts may not be identical for all the parts.

20 [0020] The process is also characterized in that the junction is not necessarily rectilinear but may have a local curvature, the radius of curvature preferably being greater than five external hem radii.

25 [0021] The assembly process according to the invention is also characterized in that, after the hem crimping operation, blocking of said hem with respect to the sliding of its parts along the junction section is achieved by bonding, indentation or imbrication.

30 [0022] The present invention also relates to the product obtained by the assembly process described above, characterized in that it is in the form of at least two metal parts having a hem along a junction section.

[0023] In a first preferred embodiment of the invention, the product is in the form of a two-web I-shaped girder, obtained by assembling four constituent

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parts connected by four hems along the junction section of the four parts taken in pairs.

[0024] In a second preferred embodiment of the invention, the product results from the assembly of two parts by two hems so as to form a closed cross section, at least one of the two parts having a U-shaped cross section.

[0025] The process of the invention thus allows to obtain structural components of complex form from sheet metal materials having, on the one hand, a high to very high elastic limit, and, on the other hand, limited formability. The latter is not a constraint as regards preparatory operations for the assembly process, such as bending, involving little deformation in the plane of the metal plate. This process thus allows to obtain components with a geometry which is equivalent to that obtained by drawing. Furthermore, hem assembling is compatible with the low formability of these steels, the working radius being several times the thickness, which is not the case for simple crimping, for example.

[0026] Another advantage of the invention is that the process of hem assembling or hem crimping, which is purely mechanical, allows to set aside the possible problems of weldability of steels with high mechanical characteristics.

[0027] An additional advantage of the invention is that it proposes a process for producing reinforced structural components, in particular in the motor vehicle industry.

[0028] Finally, the process of the invention, which uses a simple press for the assembly, is a cost-efficient process.

Brief description of the drawings

[0029] Figures 1 describe a conventionally produced structure of U-shaped geometry.

5 [0030] Figures 2 show the simple constituent parts for creating the same type of structure as that shown in Figures 1 according to the assembly process of the present invention.

[0031] Figures 3 show a tool for producing a structure as described in Figure 2.

10 [0032] Figure 4 shows assembly orientation variants for a U-shaped structure.

[0033] Figures 5 show a more complex embodiment of a structure of closed cross section obtained according to the assembly process of the present invention.

15 [0034] Figure 6 shows the tool used to produce a closed structure as shown in Figures 5.

[0035] Figure 7 shows another embodiment of a structure in the form of a two-web I-beam girder.

20 [0036] Figure 8 shows the tool for producing and assembling a two-web I-shaped girder.

[0037] Figure 9 shows a component of shield crossbeam type.

[0038] Figure 10 shows a component of b-pillar type.

25 [0039] Figure 11 shows a component with tongues at the ends to facilitate assembly.

[0040] Figures 12 illustrate the blocking principle of the relative sliding of the web with respect to the flange in the hem assembly process, by imbrication with alternate cut-out spaces. Figures 12a and 12b show the two metal  
30 plates just before the production of the hem.

Detailed description of several embodiments of the invention

[0041] The basic idea of the invention is to break down a structural component of complex form, usually made by draw-forming operations that are relatively incompatible with steels having high mechanical characteristics, into simple sub-components, made by forming operations such as bending, and hem-assembled.

[0042] The present invention will be described in greater detail by means of the enclosed figures.

[0043] Figure 1 shows the usual method for producing a component of U-shaped geometry. Conventionally, this type of component is obtained by drawing using a flat metal plate, as diagrammatically represented in Figure 1a. In the context of steels with a very high elastic limit, the drawing of such a component poses severe problems in terms of controlling the resilience: the form obtained substantially differs from the ideal form as shown in Figure 1b. Critical problems due to the low formability of this type of steel arise for example when the height of the U-shaped section substantially varies as indicated in Figure 1c or when, with the height of the section remaining constant, the curvature of the U-shaped girder shows substantial local variation (Figure 1d).

[0044] The principle according to the present invention proposed for producing this type of component is illustrated in Figures 2. The component is broken down into simple components, the sides 1 and 2 and the bottom 3 which are assembled by means of a hem 4.

[0045] The components 1, 2 and 3 may be obtained by folding or by bending the edge. These forming techniques only involve small deformations in the plane of the metal plate and are compatible with steels with a very high elastic limit and low formability.



[0046] Figure 3 shows a typical tool for producing this type of component by means of a press. The side parts 1 or 2 and the bottom 3 are prepared for the formation of the hem as indicated at 5. These components made by means of simple press operations are shown in the tool described in Figure 3.

[0047] The left half-view shows the closed tool, before producing the hem, and the right half-view shows the tool once the hem has been completed. The parts 7, 7' and 9 come to bear on the top slide of the press by means of springs, which are not shown, and whose compression travel is greater than the travel of the tools 8, 8' forming the hem. In the situation shown in Figure 3, the springs are compressed and press, by means of the parts 7 and 9, the components 1, 2 and 3 against the component 10 which matches their form and rests on the press table. When the press slide comes to the end of its travel, the part 8', which is directly connected to it, forms the hem as indicated in the right-hand side of Figure 3.

[0048] All components 1, 2 and 3 are not necessarily made of steel with a high elastic limit: for example, depending on the function of the component, it is possible for only the component 3 to be made of steel with a very high elastic limit, the steel components 1 and 2 having better formability and better weldability, thus allowing the component to be readily assembled onto the rest of the structure by means of assembly processes such as spot welding. The process also allows to adapt the thicknesses to the structural requirements of the component: the three components 1, 2 and 3 may have different thicknesses, the hem assembly process accepting substantially different thicknesses, the ratio of which is greater than two.

[0049] Orientation variants of the hemming are shown in Figure 4.

[0050] The process also allows to produce closed cross sections as indicated in Figure 5. According to Figure 5, the component 11 may be obtained by simple bending, a variation of the closed cross section being obtained by varying the height of the bent edges. The component 12, which closes the cross section, is of even simpler form. As a variant of this case, the component 11 may also be made by drawing a steel with a lower elastic limit, for example of less than 400 MPa, the component 12 being made of steel with a very high elastic limit and acting as reinforcement.

[0051] A typical set of tools for producing this type of component is shown in Figure 6. The principle is similar to that described in Figure 3. The parts 14, 14' and 15 come to bear on the top slide of the press by means of springs, that are not shown.

[0052] The part 15 holds the components 10 and 11 against the part 17-17' which rests on the lower table of the press.

[0053] In the left-hand side of the figure, the situation before the formation of the hem is shown: the press slide has brought the parts 14 and 15 into contact, the springs being slightly compressed. The right-hand view shows the situation after forming the hem: the press slide has continued its travel and the part 16', which is directly connected thereto, has formed the hem.

[0054] Another possible embodiment of a closed structure is based on assembling the components by means of four hems. A typical cross section corresponding to this application is shown in Figure 7. The components 22 and 22' are hem-assembled with the components 21 and 21'.

[0055] Figure 8 shows a set of tools for hem-assembling this cross section by means of a press. The components 21 and 22 are prepared so as to form the hem as indicated at

23: they have received a preform which initiates the hem. The components are then placed in the set of tools which is composed of moving parts 20 and 20', 19 and 19'. These parts are first separated, horizontally for 20 and 20', and vertically for 19 and 19'. The components 21 and 21' are respectively placed on 19 and 19' and held by means that are not shown, for example a magnetic system. Similarly, the components 22 and 22' are placed on the parts 20 and 20' and held in the same way. All the tools of type 18 (18', 18'', 18''') are then in the position indicated for the tool 18. The tools 18 are then successively or simultaneously moved to form the hem and arrive in the position indicated by 18', 18'', 18'''. This type of tooling can be mounted on a press, the parts 19, 18 and 18' being implemented by means of the top slide of the press: 19 is spring-mounted and its travel is limited by a stop, that is not shown. The part 19' rests on the press table and is thus fixed, the tools 18'' and 18''' being set in motion by means of the bottom slide of the press. This type of assembly by means of a press tool allows to produce forms with non-permanent cross section: the distance between the components 21 and 21' and also the distance between the components 22 and 22' can vary.

[0056] The potential applications relate to different types of motor vehicle structural components, for instance body reinforcing components (shield crossbeam), b-pillars, side rail components or engine mounts. Some of these applications are illustrated in Figures 8 to 10.

[0057] The technique allows to produce structures of complex form with steels of very low ductility by taking advantage of the production efficiency of the hem assembly process and of the reinforcement it provides to the structure. It also allows to form metal tongues at the ends of the parts, enabling these components to be readily

assembled onto the rest of the motor vehicle structure (Figure 11).

[0058] The hem assembly ensures very good maintenance of metals in the plane perpendicular to the axis of the hem. However, there is an appreciable risk that the assembled parts may slide in the axis of the hem or at least in the longitudinal direction, if the hem is not rectilinear. This drawback may be readily solved, for example by placing an adhesive between the two sheets of metal at the hem, by producing welds by local fusion or, preferably, by locally crushing the hem with a press tool comprising, for example, a V-shaped punch with a rounded end and a flat anvil. This operation may be performed in a highly efficient manner with a press: a set of tools may be designed to simultaneously perform the indentations, the indentation pitch being of the order of 5 to 10 times the outside diameter of the hem.

[0059] Alternate serrated cut-outs may also be made in the two metal sheets in the region to be hem-assembled so as to ensure longitudinal blocking (Figures 12). These cut-outs are made during the steps of manufacturing these components by press. The teeth 20 have a height that is less than the circumference of the hem, for example one-third of this circumference. The width of the teeth 20 is slightly less than that of the gaps 21 between the teeth. During the hem-assembling of the two metal sheets, the teeth of the plate closest to the axis of the hem are imbricated in the space between the teeth of the outer metal sheet, thus producing blocking in the axis of the hem.

CLAIMS

1. Process for assembling at least two simple sheet metal parts (1, 2, 3; 11, 12; 21, 21', 22, 22'), in order to create a structural component of open cross section, which is preferably U-shaped, or of closed cross section, at least one of said metal parts having a high or very high elastic limit and low formability, characterized in that:

- the metal parts are formed by at least one bending process;
- the metal parts are arranged relative to each other in a junction section;
- the metal parts are assembled by crimping at the hem (4) along the junction section of said parts.

2. Assembly process according to Claim 1, characterized in that at least one of the parts is made of steel and has an elastic limit of more than 400 MPa.

3. Assembly process according to Claim 1, characterized in that at least one of the parts is made of aluminium alloy and has an elastic limit of more than 200 MPa.

4. Assembly process according to any one of Claims 1 to 3, characterized in that the ratio of the radius of the hem (4) to the sum of the thicknesses of the various parts one wishes to assemble along the junction section is between 2 and 10.

5. Assembly process according to any one of Claims 1 to 3, characterized in that the ratio of the difference between the radius of the hem (4) and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

6. Assembly process according to any one of the preceding claims, characterized in that the nature or thickness of the various parts is not identical for all.

7. Assembly process according to any one of the preceding claims, characterized in that the junction is not rectilinear and has a local curvature, the radius of which is more than at least five times the external radius of the hem (4).

8. Assembly process according to any one of the preceding claims, characterized in that, after said hem crimping, blocking of said hem with respect to the sliding of the assembled parts along the junction section is achieved by bonding, indentation or imbrication.

9. Product obtained by the assembly process described in any one of the preceding claims, characterized in that it has at least two metal parts (1, 2, 3; 11, 12; 21, 21', 22, 22') assembled with a hem (4) along a junction section of said parts.

10. Product according to Claim 8, characterized in that the ratio of the radius of the hem (4) to the sum of the thicknesses of the various parts that are assembled along the junction section is between 2 and 10.

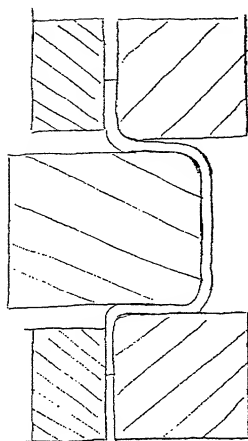
11. Product according to Claim 8 or 9, characterized in that the ratio of the difference between the hem (4) radius and the thickness of the outermost metal with the thickness of the innermost metal is more than 2.

12. Product according to any one of Claims 8 to 10, characterized in that it is in the form of a two-web I-shaped girder obtained by assembling four constituent parts (21, 21', 22, 22') connected by four hems (4) along the junction section of the four parts taken in pairs.

13. Product according to any one of Claims 8 to 10, characterized in that it results from the assembly of two parts (11, 12) by means of two hems (4) so as to form a

closed cross section, at least one of the two parts having a U-shaped cross section.

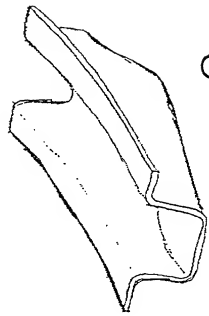
10010209.010402



A



B



C



D

Fig. 1



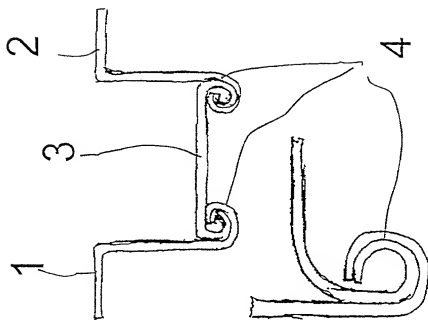
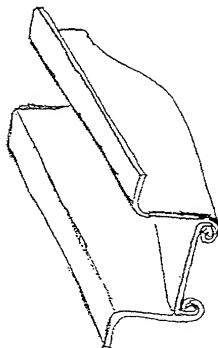
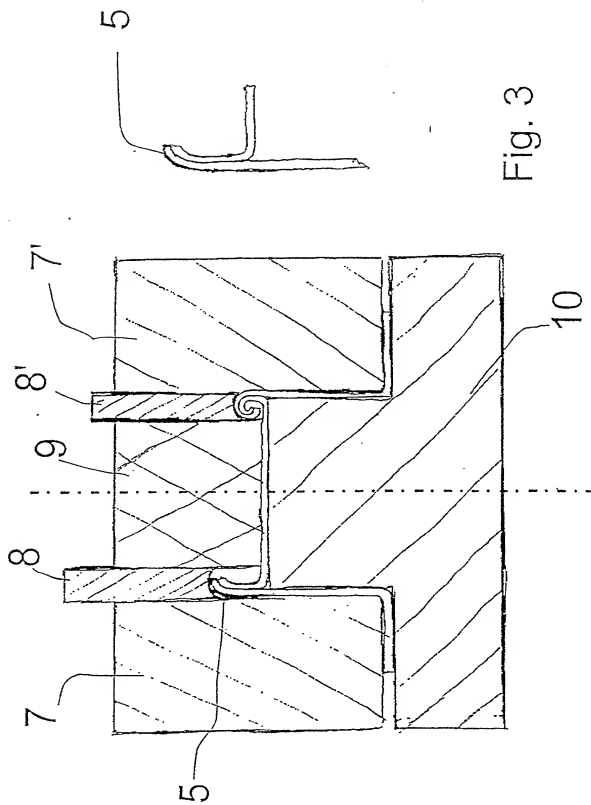


Fig. 2



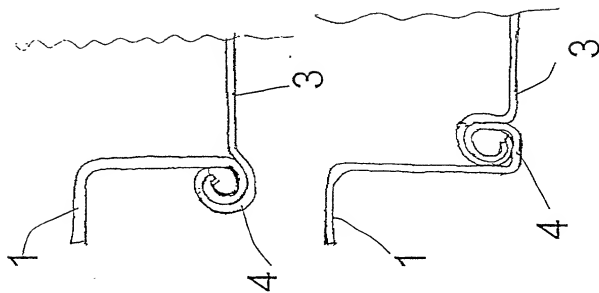


Fig. 4

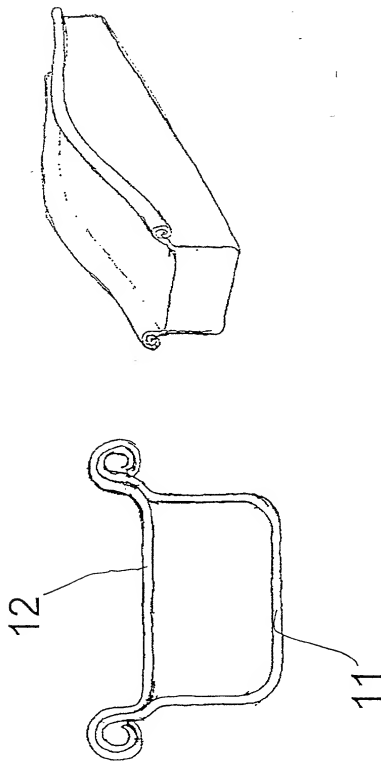


Fig. 5

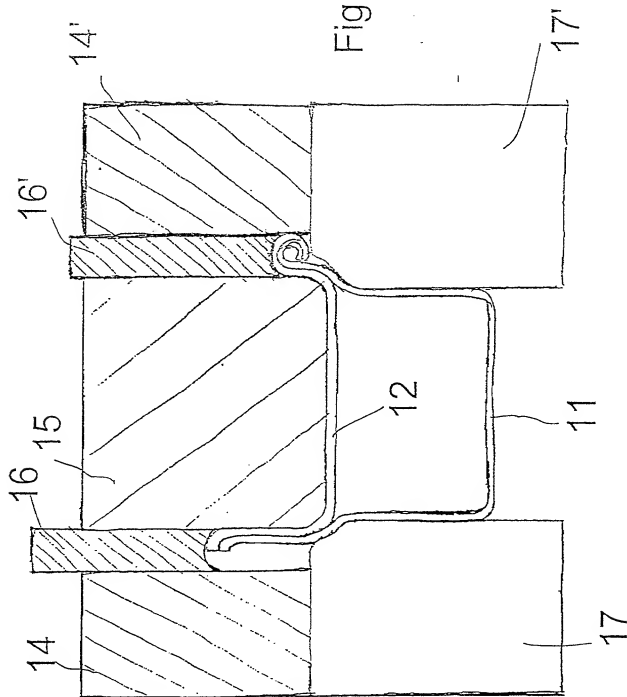


Fig. 6

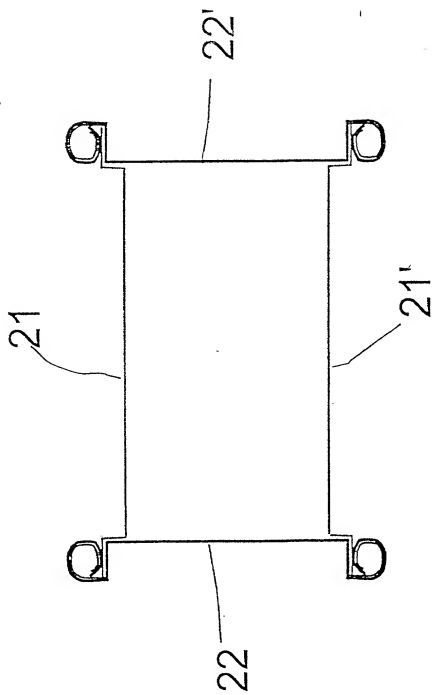
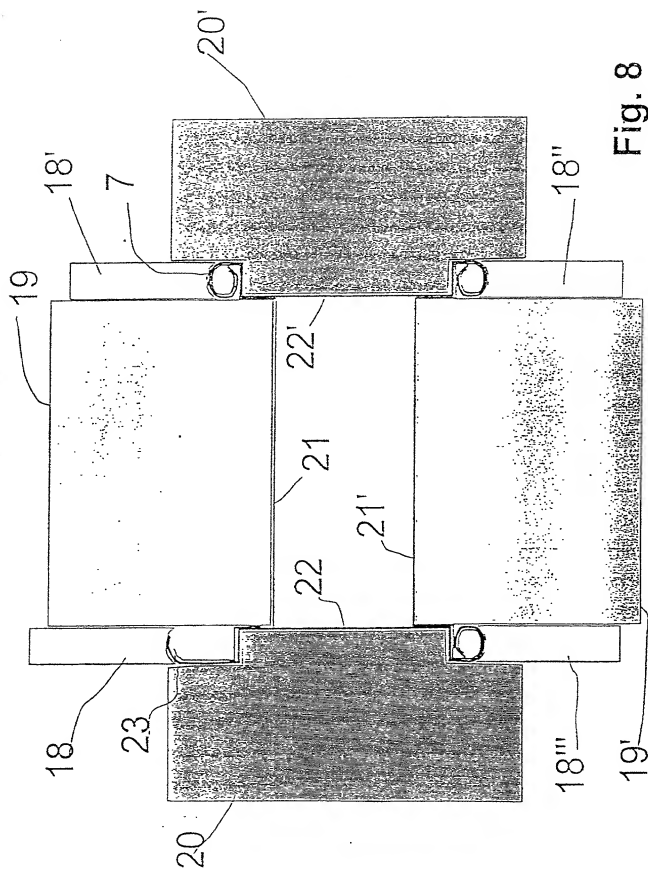


FIG. 7



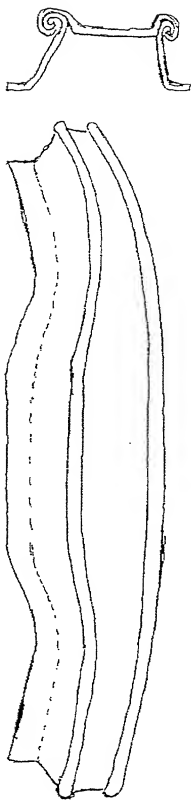


Fig. 9



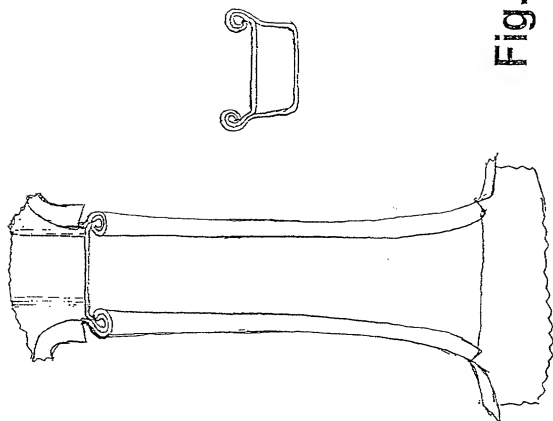


Fig. 10

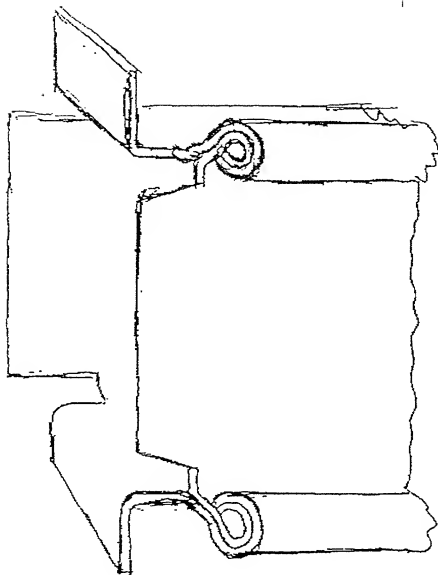


Fig. 11

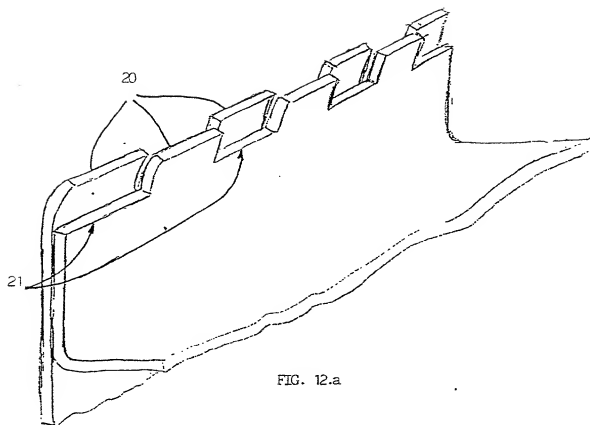


FIG. 12.a

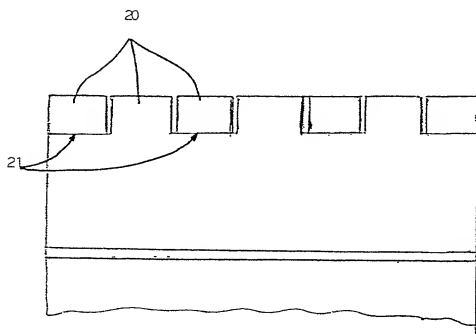


FIG. 12.b

## **Declaration and Power of Attorney for Patent Application**

### **Déclaration et Pouvoirs pour demandes de brevet**

#### **French Language Declaration**

En tant que l'inventeur nommé ci-après, je déclare par le présent acte que :

Mon domicile, mon adresse postale et ma nationalité figurant ci-dessous à côté de mon nom,

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) du sujet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée :

et dont les caractéristiques sont fournies ci-joint à moins que la case suivante n'ait été cochée :

- ☐ a été déposé le  
sous le numéro de Demande des Etats-Unis ou  
sous le numéro de demande internationale  
PCT et modifiée le  
(le cas échéant).

Je déclare par le présent acte avoir passé en revue et pris connaissance du contenu des caractéristiques ci-dessus, revendications comprises, telles que modifiées par tout amendement dont il aura été fait référence ci-dessus.

Je reconnais de voir divulguer toute information pertinente à l'examen de cette demande, comme le définit le Titre 37, §1.56 du Code fédéral des réglementations.

As a below named inventor, I hereby declare that :

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled :

"Process for assembling at least two constituent metal parts in order to create a structure"

the specification of which is attached hereto unless the following box is checked :

- ☒ was filed on July 5<sup>th</sup>, 2000  
as PCT International Application Number PCT/BE00/00080 and was amended on September 5<sup>th</sup>, 2001.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

## French Language Declaration

Je revendique par le présent acte avoir la priorité étrangère, en vertu du Titre 35, § 119 du Code des Etats-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur figurant ci-dessous et ai aussi pris connaissance de toute demande étrangère de brevet ou de tout certificat d'inventeur ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

Prior foreign applications

Demande(s) de brevet antérieure(s)

(Number) (Country)  
99202194.9 EP

(Number) (Country)  
(Numéro) (Pays)

(Number) (Country)  
(Numéro) (Pays)

Je revendique par le présent acte tout bénéfice, en vertu du Titre 35, § 120 du Code des Etats-Unis, de toute demande de brevet effectuée aux Etats-Unis figurant ci-dessous et, dans la mesure où le sujet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande américaine préalable, en vertu des dispositions de premier paragraphe du Titre 35, § 112 du Code des Etats-Unis, je reconnais devoir divulguer toute information pertinente à la demande de brevet comme défini dans le Titre 37, § 1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la première demande et la date de dépôt de la demande nationale ou PCT internationale :

(Application Serial No.) (Filing date)  
(No. de série de la demande) (Date de dépôt)

(Application Serial No.) (Filing date)  
(No. de série de la demande) (Date de dépôt)

Je déclare par le présent acte que toute déclaration ci-incluse est, à ma connaissance, véridique et que toute déclaration formulée à partir de renseignements ou de suppositions est tenue pour véridique; et de plus, que toutes ces déclarations ont été formulées en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une incarcération, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des Etats-Unis et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

I hereby claim foreign priority under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed.

Priority claimed  
Droit de priorité revendiqué

	●	○
(Day/Month/Year Filed)	Yes	No
(5th/July/1999)	Oui	Non
	○	○
(Day/Month/Year Filed)	Yes	No
(Jour/Mois/Année de dépôt)	Oui	Non
	○	○
(Day/Month/Year Filed)	Yes	No
(Jour/Mois/Année de dépôt)	Oui	Non

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application :

(Statut)	(Status)
(Breveté, en attente, annulé)	(Patented, pending, abandoned)
(Statut)	(Status)
(Breveté, en attente, annulé)	(Patented, pending, abandoned)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful and false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.

## French Language Declaration

POUVOIRS : En tant que l'inventeur cité, je désigne par la présente l(les) avocat(s) et/ou agent(s) suivant(s) pour qu'il(s) poursuive(nt) la procédure de cette demande de brevet et traite(nt) toute affaire avec le Bureau des brevets et marques s'y rapportant.

(mentionner le nom et le numéro d'enregistrement)

POWER OF ATTORNEY : As named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and trademark Office connected there with.

(list name and registration number)

Adresser toute correspondance à :

Send Correspondence to :

Adresser tout appel téléphonique à :  
(nom et numéro de téléphone)

Direct Telephone Calls to :  
(name and telephone number)

Nom complet de l'unique ou premier inventeur 1-00	Full name of sole or first inventor KERGEN Richard
Signature de l'inventeur Date	Inventor's signature 28.11.01 Date
Domicile	Residence Fexhe-Le-Haut-Clocher BEX
Nationalité	Citizenship Belgian
Adresse postale	Post Office Address Rue de la Gare, 10/1 B-4347 FEXHE-LE-HAUT-CLOCHER BELGIUM

(Fournir les mêmes renseignements et la signature de tout co-inventeur supplémentaire)

(Supply similar information and signature for any subsequent joint inventor)

